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NATIONAL DAM SAFETY PROGRAM. DEAL LAKE DAM (MO 10982), MISSISSI--ETC(U)
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MISSISSIPPI·SALT·QUINCY RIVER BASIN

AD A104977

DEAL LAKE DAM
MONROE COUNTY, MISSOURI
MO. 10982

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
Serving the Army
Serving the Nation

St. Louis District

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

NOVEMBER 1979

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This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Deal Lake Dam (Mo. 10982) Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Deal Lake Dam (Mo. 10982).

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood
2) Overtopping could result in dam failure
3) Dam failure significantly increases the hazard to loss of life downstream

SUBMITTED BY: SIGNED
Chief, Engineering Division
17 DEC 1979
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer
17 DEC 1979
Date

DEAL LAKE DAM

MONROE COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10982

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
CONSOER, TOWNSEND AND ASSOCIATES, LTD.
ST. LOUIS, MISSOURI
AND
ENGINEERING CONSULTANTS, INC.
ENGLEWOOD, COLORADO
A JOINT VENTURE

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
FOR
GOVERNOR OF MISSOURI

NOVEMBER 1979

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Deal Lake Dam, Missouri Inv. No. 10982
State Located: Missouri
County Located: Monroe
Stream: An Unnamed Tributary of Long Branch
Date of Inspection: June 12, 1979

Assessment of General Condition

Deal Lake Dam was inspected by the engineering firms of Consoer, Townsend & Associates Ltd., and Engineering Consultants, Inc. (A Joint Venture) of St. Louis, Missouri using the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of Federal and State agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

The observed cracks should be further investigated to determine the seriousness of the condition and to insure that the cracking is not related to slope movement. Large cracks should be repaired.

Based on the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. The estimated damage zone extends approximately three miles downstream of the dam. Within the damage zone are four dwellings, a few buildings, a crossing of Highway C and a road and bridge which may be subjected to flooding, with possible damage and/or destruction, and possible loss of life. The Deal Lake Dam is in the small size classification since it is less than 40 feet high and impounds less than 1,000 acre-feet of water.

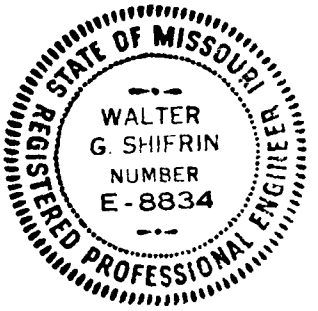
Our inspection and evaluation indicates that the spillway of Deal Lake Dam does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Deal Lake Dam, being a small size dam with a high hazard potential, is required by the guidelines to pass from one-half of the the Probable Maximum Flood to the Probable Maximum Flood without overtopping. Since there is high hazard potential downstream of the dam, the appropriate spillway design flood for this dam is the Probable Maximum Flood. It was determined that the reservoir/spillway system can accommodate only 12 percent of the Probable Maximum Flood without overtopping the dam. Our evaluation also indicates that the reservoir/spillway system will not accommodate the 100-year flood without overtopping the dam. However, the reservoir/spillway system of Deal Lake Dam can accommodate the 10-year flood without overtopping.

The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region. The 10-and 100-year floods are defined as floods having a ten percent and a one percent chance, respectively, of being equalled or exceeded during any given year.

Other deficiencies noted by the inspection team were: erosion along the upstream crest; brush in the discharge channel; A partially clogged principal spillway; a lack of periodic inspection by a qualified engineer and a lack of maintenance schedule. The lack of seepage and stability analyses on record is also a deficiency.

It is recommended that the owner take action to correct or control the deficiencies described above.

Walter G. Shifrin, P.E.



Overview of Deal Lake Dam

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEAL LAKE DAM, I.D. No. 10982

TABLE OF CONTENTS

TABLE OF CONTENTS

(Continued)

TABLE OF CONTENTS

(Continued)

LIST OF PLATES

APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEAL LAKE DAM, Missouri Inv. No. 10982

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The Dam Inspection Act, Public Law 92-367 of August, 1972, authorizes the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspections. Inspection for the Deal Lake Dam was carried out under Contract DACW 43-79-C-0075 between the Department of the Army, St. Louis District, Corps of Engineers, and the engineering firms of Consoer, Townsend & Associates Ltd., and Engineering Consultants, Inc. (A Joint Venture), of St. Louis, Missouri.

b. Purpose of Inspection

The visual inspection of the Deal Lake Dam was made on June 12, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an assessment of hydrologic and hydraulic conditions at the site; presents an assessment as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

Subsurface investigations, laboratory testing, and detailed analyses were not within the scope of this study. The conclusions drawn herein, therefore, are based on the presence of, or absence of, obvious signs of distress. No warranty as to the absolute safety of the project features is implied by the conclusions presented in this report.

It should be noted that reference in this report to left or right abutments is as viewed looking downstream. Left abutment or left side of the dam as used in this report refers to the west abutment or side and right to the east abutment or side.

d. Evaluation Criteria

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D. These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 Description of Project

a. Description of Dam and Appurtenances

It should be noted that design drawings are not available for the dam or appurtenant structures. The following description is based exclusively on observations and measurements made during the visual inspection.

The dam consists of an earthfill embankment between earth abutments. The crest is 15 feet wide with a length of approximately 1,142 feet. The elevation of the lowest point on the crest is 801.5 feet above M.S.L. and the maximum embankment height is about 22 feet.

The downstream slope of the embankment was measured to be approximately 2H to 1V. While it was not possible to measure the upstream slope, it was reported by Mr. Carl Anderson (an employee of the owner) that the slope was 3H to 1V with a berm constructed upstream. There was no riprap on the slope.

The dam is situated in the Dissect Till Plains Section of Central Lowlands Province, (Fenneman, N.M., "Physiography of Eastern United States", 1946). The area was glaciated during Pleistocene time, at the close of which, relatively thick amounts of glacial till were deposited on the underlying bedrock.

The regional geologic setting of the dam places it over rocks dipping northward at about 30-50 feet per mile. There is a known anticline some seven miles northwest of the site and another known anticline some eight miles to the south ("Structural Features of Map of Missouri", 1971). These two structures are not thought to affect the beds under the dam.

The beds underlying the site are thought to be from the Cabiness Subgroup of the Cherokee Group (Pennsylvanian)(Geologic Map of Missouri, 1979). These beds are cyclic deposits predominately of sandstone and shale (claystone) with some associated wall beds. It is also possible that the underlying rocks are of the Osagean Series (Mississippian) as the contact shown on the map is very close to the site. These rocks are predominately limestone and dolomitic limestone.

A 12-inch diameter steel pipe is located at the approximate center of the dam and functions as the principal spillway. An emergency spillway, approximately 46 feet wide, was cut into the right abutment.

b. Location

Deal Lake Dam is located on an unnamed tributary of Long Branch. A general location map of the dam is presented as Plate 1, page P-2. The dam and the lake are shown on the Rowena and Tulip Missouri Quadrangle Sheets (7.5 minute series) in Section 27, Township 53 North, Range 11 West (Plate 1, Appendix B).

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams", by the U.S. Department of the Army, Office of the Chief Engineer, the dam is classified in the dam size category as being "Small" since its storage is less than 1,000 acre-feet. The dam is also classified as "Small" in dam height category because its height is less than 40 feet. The overall size classification is, accordingly, "Small" in size.

d. Hazard Classification

The dam has been classified as having "High" hazard potential in the National Inventory of Dams, on the basis that in the event of failure of the dam or its appurtenances, excessive damage could occur to downstream property, together with the possibility of the loss of life. Our findings concur with the classification. The estimated damage zone extends approximately three miles downstream of the dam. Within the damage zone are four dwellings, a few buildings, a crossing of Highway C and a road and bridge.

e. Ownership

Deal Lake Dam is owned by Mr. Ronnie Deal, Route 3, Morrisonville, Illinois 62546.

f. Purpose of Dam

The purpose of the dam is for agricultural irrigation.

g. Design and Construction History

The dam was constructed in 1975 by the R.J. Levings Construction Company of Madison, Missouri. No design or construction data, however, was available from the construction company. According to the previous owner no formal engineering plans were compiled, but advice was provided by the local soil conservation service. No records, however, were available.

h. Normal Operational Procedures

There are no defined operational procedures for the lake. The lake is allowed to remain as high as possible and is controlled by rainfall, runoff, evaporation and uncontrolled spillway releases.

1.3 Pertinent Data

a. Drainage Area (square miles): 0.56

b. Discharge at Damsite

Estimated experienced maximum flood (cfs):	N/A
Estimated ungated spillway capacity with reservoir at top of dam elevation (cfs):	154

c. Elevation (feet above MSL)

Top of dam:	801.5 (Lowest point on the dam crest)
Spillway crest:	
Principal Spillway (Partially clogged)	794.9±
Emergency Spillway	800
Normal Pool	800
Maximum Pool (PMF):	803.26

d. Reservoir

Length of pool with water surface at top of dam elevation:	2,400

e. Storage (Acre-Feet)

Top of dam:	405
Spillway crest:	
Principal Spillway (Partially clogged)	187±
Emergency Spillway	341
Normal Pool:	341
Maximum Pool (PMF):	524

f. Reservoir Surface (Acres)

Top of dam:	46

Spillway crest:	
Principal Spillway (Partially clogged)	24
Emergency Spillway	39
Normal Pool:	39
Maximum Pool (PMF):	53±

g. Dam

Type:	Earthfill
Length:	1,142 feet
Structural Height:	22 feet
Hydraulic Height:	22 feet
Top width:	15 feet
Side slopes:	
Downstream	1V to 2H
Upstream	1V to 3H
Zoning:	Unknown
Impervious core:	Unknown
Cutoff:	Unknown
Grout curtain:	Unknown

h. Diversion and Regulating Tunnel None

i. Spillway

Type:	
Principal Spillway	12-inch diameter steel pipe (partially clogged)
Emergency Spillway	Open channel, uncontrolled
Length of weir:	
Principal Spillway	12-inch diameter steel pipe (partially clogged)
Emergency Spillway	20 feet
Crest Elevation (feet above MSL):	
Principal Spillway	794.9 feet $\pm$
Emergency Spillway	800 feet

j. Regulating Outlets — None

SECTION 2 : ENGINEERING DATA

2.1 Design

No design drawings or data are available for Deal Lake Dam.

2.2 Construction

According to Mr. Deal (the owner) the dam was constructed in 1975 by the R.J. Levings Construction Company of Madison, Missouri. No construction records or as built drawings were available. The source of the embankment materials is unknown, however, it is probable that soils within the immediate area of the dam were used.

2.3 Operation

No operation records are available for the Deal Lake Dam.

2.4 Evaluation

a. Availability

The availability of engineering data is poor and consists only of State Geological Maps and U.S.G.S. Quadrangle Sheets. No information on subsurface investigations or soil testing was available. No information on design hydrology or hydraulic design was available.

b. Adequacy

The conclusions presented in this report are based on simple field measurements, the available engineering data, past performance and present condition of the dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions and made a matter of record.

c. Validity

Not applicable, as no design or construction records were available.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

A visual inspection of Deal Lake Dam was made on June 12, 1979. The following persons were present during the inspection:

Name	Affiliation	Disciplines
David J. Kerkes	Engineering Consultants, Inc.	Soils
Peter Howard	Engineering Consultants, Inc.	Geology
Mark R. Haynes	Engineering Consultants, Inc.	Civil, Structural and Mechanical
Kenneth L. Bullard	Engineering Consultants, Inc.	Hydraulics and Hydrology
Kevin Blume	Consoer, Townsend & Assoc., Ltd.	Civil and Structural
Ronnie Deal	Owner	
Carl Anderson	Employee of Owner	

Specific observations are discussed below.

b. Dam

The crest of the dam had a well maintained cover of grass. No trees were growing along the crest. There was a small depression, about 6 inches, over the 12 inch diameter steel pipe. There were a considerable number of discontinuous longitudinal cracks along the upstream and downstream edges of the crest. The cracks had a maximum length of about 6 feet, were up to 3/4 inch wide and a had maximum depth of 10 or 12 inches. No significant deviations in horizontal or vertical alignment were apparent. Material exposed on the embankment appeared to be clayey silts and clays. According to Mr. Deal the dam has never been overtopped, to the best of his knowledge.

The upstream slope was only partially visible for inspection owing to the reservoir level. Considerable erosion is occuring along the entire slope. Wave action is eroding the slope and causing small blocks of soil to slough off into the reservoir. Some of the cracks on the upstream side of the crest are believed to be tension cracks related to this action. The slope is not protected by riprap. There were no other readily apparent signs of past or present distress in the upstream slope. There were no trees or brush growing on the slope.

The downstream slope had an unmowed cover of grass with no signs of erosion. There were no trees or bushes growing on the slope. There were no bulges or depression indicative of past or present slope instability. There were no cracks observed in the downstream slope. The majority of

the ground was marshy, indicative of a high water table in the area, however, no boils or flowing seepage was observed along the toe of the dam. No cracks were apparent on the slope.

Both the left and right abutments were at approximately the same elevation as the crest of the dam. Both abutments appeared to be natural earth material with good grass protection. No erosion or cracking was observed in either abutment along the embankment contact. No seepage was observed in or around either abutment. No evidence of slope movement was apparent in either abutment. There were no readily apparent signs of damage to either the embankment or abutments due to burrowing animals at the time of the inspection.

At the dam site Pleistocene Glacial Till overlies Pennsylvanian Sandstone and Shale of the Cherokee Group, Cabanis Subgroup and/or limestone and Dolomitic limestone of the Mississippian Osagean series. No rock outcrops were observed in the area.

c. Appurtenant Structures

(1) Spillways

The principal spillway appears to be a 12 inch diameter steel pipe located near the center of the dam. The upstream invert is believed to be about 6 feet below the crest and the outlet is at the downstream toe. It is believed that the intake is partially clogged. The pipe was discharging at the time of the inspection, but the quantity was too large to obtain an accurate estimate.

An emergency spillway, about 46 feet wide, is cut into the right abutment. The spillway invert is about 2 feet below the crest. The spillway is grass lined. Some cracking, believed to be due to shrinkage, was observed in the spillway.

(2) Outlet Works

There is no operating outlet pipe or low level drain pipe at the dam.

d. *Reservoir Area*

The water surface elevation was at 798.9 feet above MSL on the day of the inspection.

The slopes along the reservoir rim are gentle with good grass protection. No evidence of past or present instability of the slopes was readily apparent.

e. Downstream Channel

The downstream channel of the 12 inch diameter conduit is a well-defined stream channel. The channel was obstructed with weeds. The channel extends for a few hundred feet downstream through a box culvert in a farm road and then flows into Long Branch.

The downstream channel of the emergency spillway is a well-defined, grass-lined channel which was not obstructed. The channel flows into an open grassy pasture.

3.2 Evaluation

The visual inspection did not reveal any conditions which were felt to pose an immediate threat to the safety of the structure, however, certain conditions do exist which warrant attention. The following items were observed which could affect the safety of the dam or which will require maintenance within a reasonable period of time.

1. The erosion due to wave action on the upstream slope, if allowed to continue, could jeopardize the structural stability of the embankment.

2. The obstruction in the 12-inch diameter steel pipe decreases the hydraulic capacity of the pipe and thus increases the potential of overtopping of the dam.

3. It is unknown whether the cracks along the upstream and downstream sides of the crest are indicative of shrinkage, slope movement or foundation settlement. The cracks should be further investigated to insure that they are not related to possible distress in the slope or foundation.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Deal Lake is used primarily for irrigation, and has no defined procedures for operation. Water level in the reservoir is controlled by rainfall, runoff, evaporation and unregulated spillway releases.

4.2 Maintenance of Dam

The owner, Mr. R.E. Deal employs a caretaker who lives near the lake and dam. The crest and slopes of the structure are kept clear of trees and brush. There is at this time, a problem with erosion on the upstream slope at the water level. No apparent steps are being taken to control this problem.

4.3 Maintenance of Operating Facilities

There are no operable facilities at the damsite at this time. The 12 inch diameter spillway pipe intake was noticed to be submerged on the day of inspection and is apparently partially clogged.

4.4 Description of Any Warning System in Effect

The inspection team is not aware of any existing warning system in effect.

4.5 Evaluation

The crest and downstream slope appear to be adequately maintained. However, more attention should be given to the erosion occurring along upstream slope. The vegetation growing in the discharge channel should also be controlled. The 12 inch diameter spillway should be unclogged and protected from future clogging.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The watershed area of Deal Lake Dam upstream from the dam axis consists of approximately 361 acres. Most of the watershed area is farmland with some forested areas. Land gradients in the higher regions of the watershed average roughly 1 percent, and in the lower areas surrounding the reservoir average about 4 percent. Deal Lake Dam is located on an unnamed tributary of Long Branch. The reservoir is about 0.2 mile upstream from the confluence of the unnamed tributary and Long Branch. At its longest arm the watershed is approximately 0.6 mile long. A drainage map showing the watershed area is presented as Plate 1 in Appendix B.

Evaluation of the hydraulic and hydrologic features of Deal Lake Dam was based on criteria set forth in the Corps of Engineers' "Recommended Guidelines for Safety Inspection of Dams", and additional guidance provided by the St. Louis District of the Corps of Engineers. The Probable Maximum Flood (PMF) was calculated from the Probable Maximum Precipitation (PMP) using the methods outlined in the U.S. Weather Bureau Publication, Hydrometeorological Report No. 33. The probable maximum storm duration was set at 24 hours, and storm rainfall distribution was based on criteria given in EM 1110-2-1411 (Standard Project Storm). The SCS method was used for deriving the unit hydrograph, utilizing the Corps of Engineers' computer program HEC-1 (Dam Safety Version). The unit

hydrograph parameters are presented in Appendix B. The SCS method was also used for determining the loss rate. The hydrologic soil group of the watershed was determined by the use of published soil maps. The hydrologic soil group of the watershed and the SCS curve number are presented in Appendix B. The curve number, the unit hydrograph parameters, the PMP index rainfall and the percentages for various durations were directly input to the HEC-1 (Dam Safety Version) computer program to obtain the PMF hydrograph. The computed peak discharges of the PMF and one-half of the PMF are 6,503 cfs and 3,252 cfs, respectively.

Both the PMF and one-half of the PMF inflow hydrographs were routed through the reservoir by the Modified Puls Method also utilizing the HEC-1 (Dam Safety Version) computer program. The reservoir level was assumed at the crest of the emergency spillway at the start of the routing computation. The peak outflow discharges for the PMF and one-half of the PMF are 5,070 and 2,222 cfs, respectively. Both the PMF and one-half of the PMF, when routed through the reservoir result in overtopping of the dam.

The stage-outflow relation for the spillway was prepared from field notes and sketches prepared during the field inspection. The reservoir stage-capacity data were based on the U.S.G.S. Rowena, Missouri and Tulip, Missouri Quadrangle topographic maps (7.5 minute series). The spillway and overtop rating curve and the reservoir capacity curve are presented as Plates 2 & 3, respectively, in Appendix B.

From the standpoint of dam safety, the hydrologic design of a dam aims at avoiding overtopping. Overtopping is especially dangerous for an earth dam because the downrush of waters over the crest can erode the dam embankment and release

all the stored water suddenly into the downstream floodplain. The safe hydrologic design of a dam requires a spillway discharge capability, in combination with an embankment crest height that can handle a very large and exceedingly rare flood without overtopping.

The Corps of Engineers designs its dams to safely pass the Probable Maximum Flood that is estimated could be generated from the upstream watershed. This is the generally accepted criterion for major dams throughout the world, and is the standard for dam safety where overtopping would pose any threat to human life. According to the Corps' criteria, the hydrologic requirement for safety for this dam is the capability to pass from one-half of the Probable Maximum Flood to the Probable Maximum Flood without overtopping.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site. However, according to the owner, the water level has never been above the crest of the emergency spillway.

c. Visual Observations

Observations made of the spillway during the visual inspection are discussed in Section 3.1c(1) and evaluated in Section 3.2.

d. Overtopping Potential

As indicated in Section 5.1a, both the Probable Maximum Flood and one-half of the Probable Maximum Flood, when routed through the reservoir, resulted in overtopping of the dam. The peak outflow discharges for the PMF and one-half of the PMF are 5,070 cfs and 2,222 cfs respectively. The PMF overtopped the dam crest by 1.76 feet and one-half of the PMF overtopped the dam crest by 1.19 feet. The total duration of embankment overflow is 13.08 hours during the PMF, and 8.33 hours during one-half of the PMF. The maximum capacity of the spillway with reservoir at top of dam elevation is 154 cfs. The spillway and the reservoir of Deal Lake Dam are capable of accommodating a flood equal to approximately 12 percent of the PMF just before overtopping the dam.

The computed one percent and ten percent chance floods using 100-and 10-year, 24 hour rainfall data were routed through the reservoir. The routing results indicate that the 100-year flood will overtop the dam by 0.45 feet and the reservoir/spillway system can accommodate the 10-year flood with a freeboard of 0.08 feet.

The failure of the dam could cause extensive damage to the property downstream of the dam and possible loss of life. The estimated damage zone extends approximately three miles downstream of the dam. Within the damage zone are four dwellings, a few buildings, a crossing of Highway C and a road and bridge.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There were no depressions or bulges apparent in the downstream slope indicating past or present instability. Erosion along the upstream slope is causing the sloughing of small blocks of soil into the reservoir and tension cracks are apparent on the upstream slope. In these areas longitudinal cracks, as described in Section 3.1b, are apparent along the downstream side of the crest and, to a lesser extent, the upstream side. It is not known if these cracks are related to shrinkage, settlement due to reservoir filling or movement in the downstream slope.

b. Design and Construction Data

No design computations were uncovered during the report preparation phase. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. No embankment or foundation soil parameters are available for carrying out a conventional stability analysis on the embankment. No construction data or specifications relating to the degree of embankment compaction are available for use in a stability analysis.

c. Operating Records

No operating records are available relating to the stability of the dam. According to the owner, the embankment has served satisfactorily since it was constructed with no history of problems.

d. Post Construction Changes

There are no records of post-construction changes.

e. Seismic Stability

The dam is located in seismic Zone 1, as defined in "Recommended Guidelines For Safety Inspection of Dams" as prepared by the Corps of Engineers, and therefore, does not require a seismic stability analysis.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

It should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is also important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there by any chance that an unsafe condition could be detected.

a. Safety

The spillway capacity of Deal Lake Dam was found to be "Seriously Inadequate". The spillway/reservoir system will accommodate only 12 percent of the PMF without overtopping the dam. Our evaluation indicates that the spillway/reservoir system can not accommodate the 100-year flood without overtopping the dam. However, the spillway and the reservoir of Deal Lake Dam will accommodate the 10-year flood without overtopping.

No definitive statement pertaining to the safety of the embankment, based on quantitative information, can be made in view of the absence of seepage and stability analyses for the dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions and made a matter of record. The present embankment, however, has reportedly performed adequately since its construction without failure or evidence of instability. The dam has reportedly never been overtopped and no evidence was uncovered indicating the contrary.

b. Adequacy of Information

The conclusions presented in this report are based on field measurements, the available engineering data, past performance and present condition of the dam. Information on the design hydrology, hydraulic design, and the operation and maintenance of the dam, as well as seepage and stability analyses were not available.

c. Urgency

A program should be developed as soon as possible to monitor at regular intervals the deficiencies described in this report. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Phase II Inspection

Based on results of the Phase I inspection, and if the remedial measures in paragraph 7.2 are undertaken as soon as possible, a Phase II inspection is not felt to be necessary.

7.2 Remedial Measures

The owner should initiate action on the following corrective measures.

a. Alternatives:

1. Spillway capacity and/or height of the dam should be increased to accommodate the PMF without overtopping the dam. The overtopping depth, during the occurrence of the PMF, stated elsewhere in this report is not the required or recommended increase in height of the dam.

b. O & M Procedures:

1. The erosion along the upstream crest should be repaired and the area should be protected with proper riprap to prevent future erosion.

2. All brush should be cleared from the discharge channel.

3. The 12 inch diameter spillway should be unclogged and protected from future clogging.

4. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of dams.

5. The observed cracks should be further investigated to determine the seriousness of the condition and to insure that the cracking is not related to slope movement. Large cracks should be repaired.

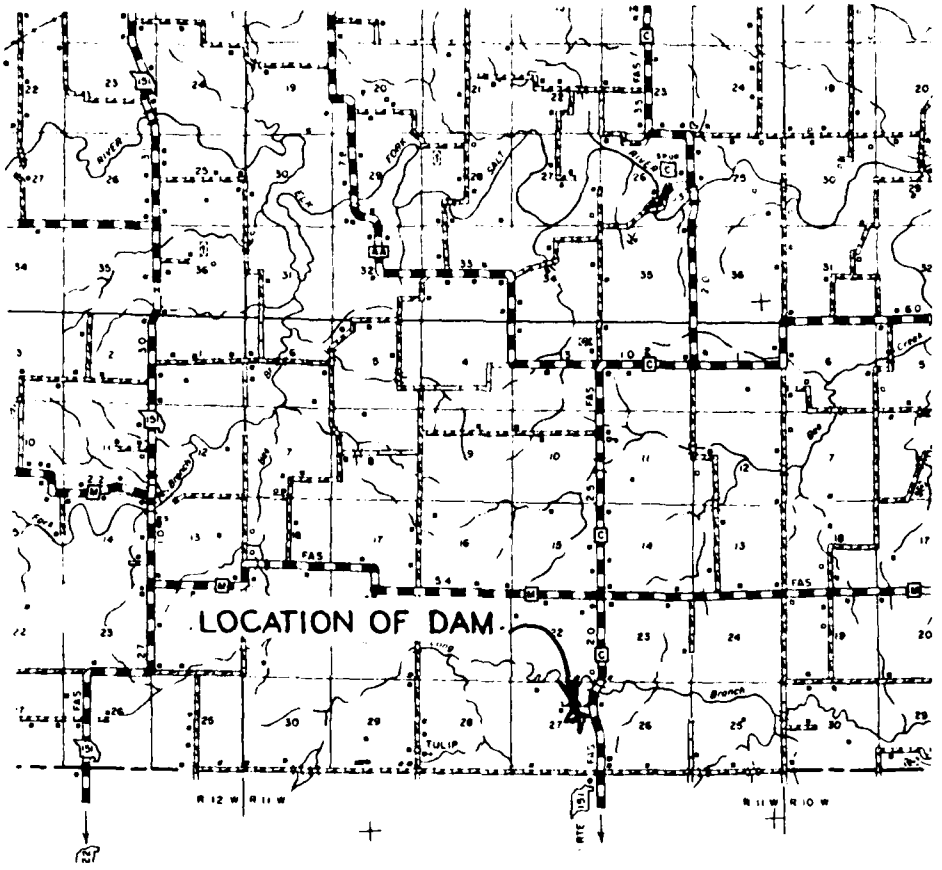
6. The owner should initiate the following programs.

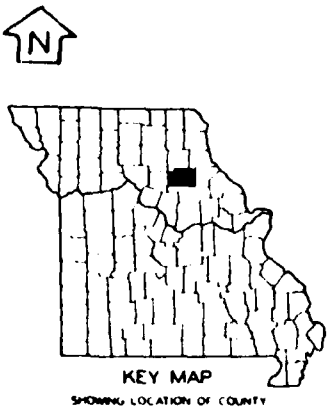
   (a) Periodic inspection of the dam by a profesional engineer experienced in the design and construction of earthen dams.

   (b) Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

PLATES

PLATE I





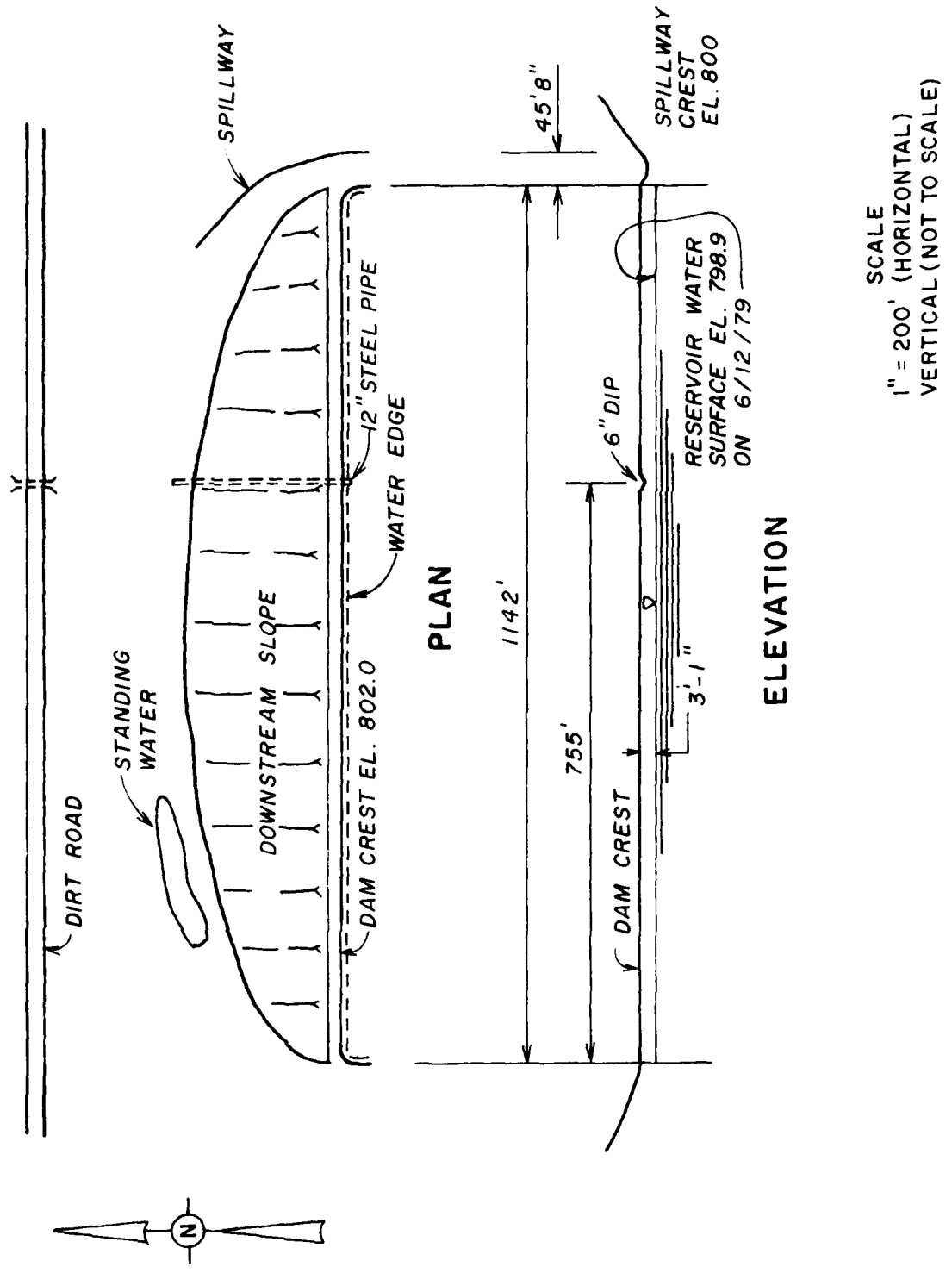
MONROE COUNTY

SCALE

0 1 2 3 4 MILES

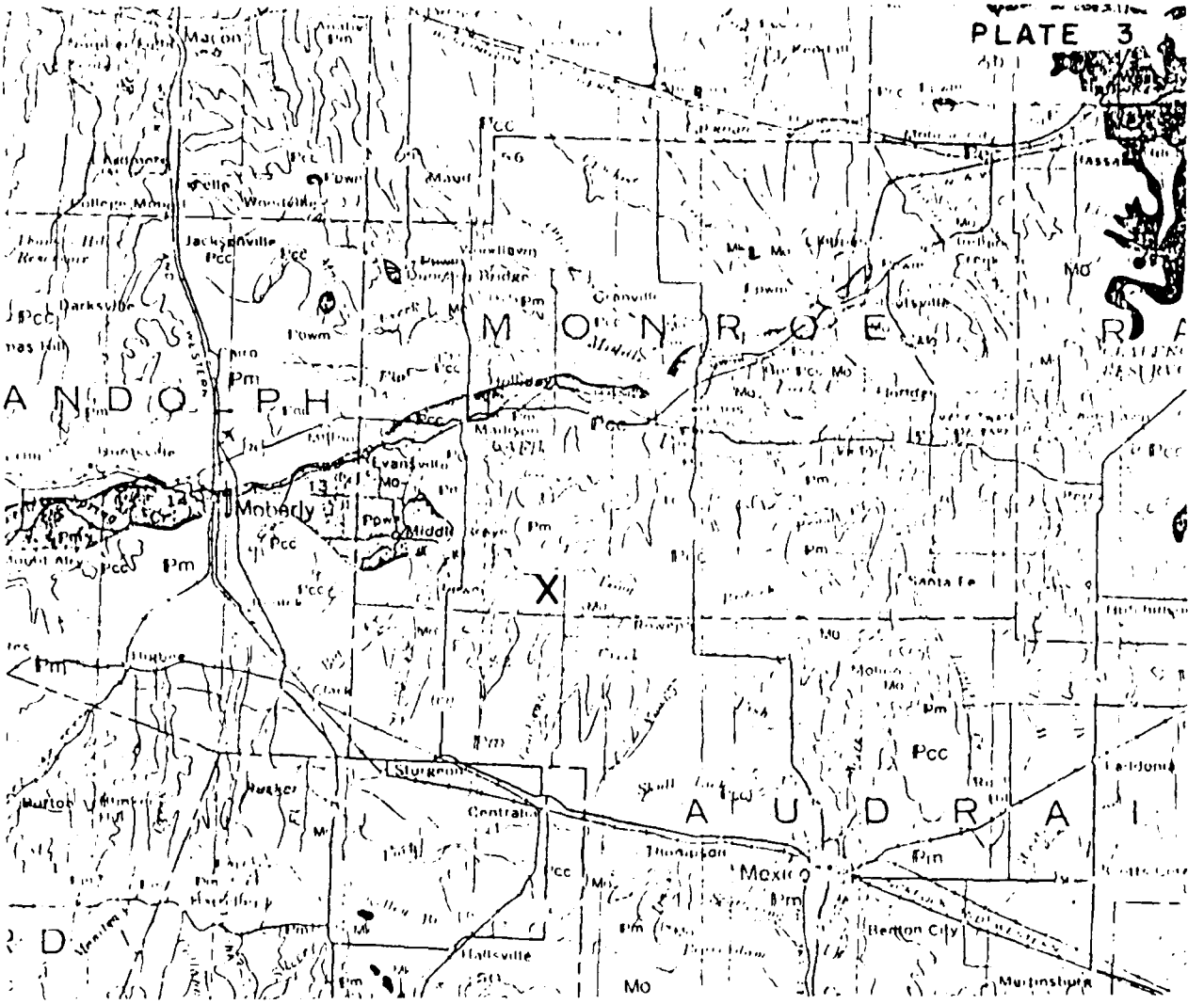
LOCATION MAP-DEAL LAKE DAM

PLATE 2



DEAL LAKE DAM (MO. 10982)
PLAN & ELEVATION

PLATE 3



PENNSYLVANIAN

- Pp - PLEASANTON GROUP
- Ppwm - WARRENSBURG - MOBERLY SANDSTONE
- Pm - MARMATON GROUP
- Pcc - CHEROKEE GROUP

MISSISSIPPIAN

- Mm - MERAMACIAN SERIES
- Mo - OSAGIAN SERIES
- Mk - KINDERHOOKIAN SERIES

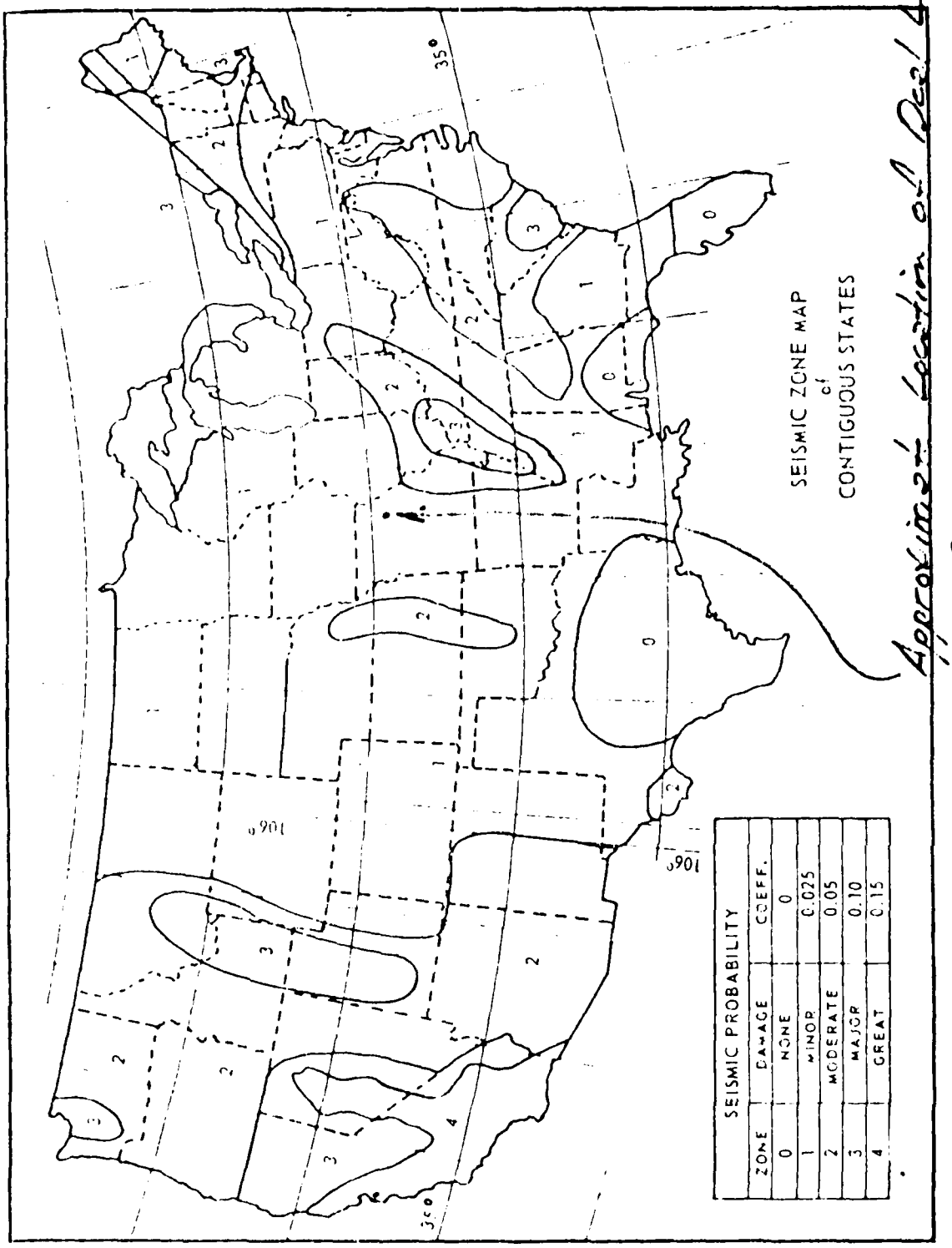
X - LOCATION OF DAM, MO. 10982

REFERENCE:

GEOLOGIC MAP OF MISSOURI,
MISSOURI GEOLOGIC SURVEY,
a) 1961 ; b) 1979

GEOLOGIC MAP OF MONROE COUNTY AND ADJACENT AREA

PLATE 4



Approximate location of Real Lake Dam.

APPENDIX A

PHOTOGRAPHS TAKEN DURING INSPECTION

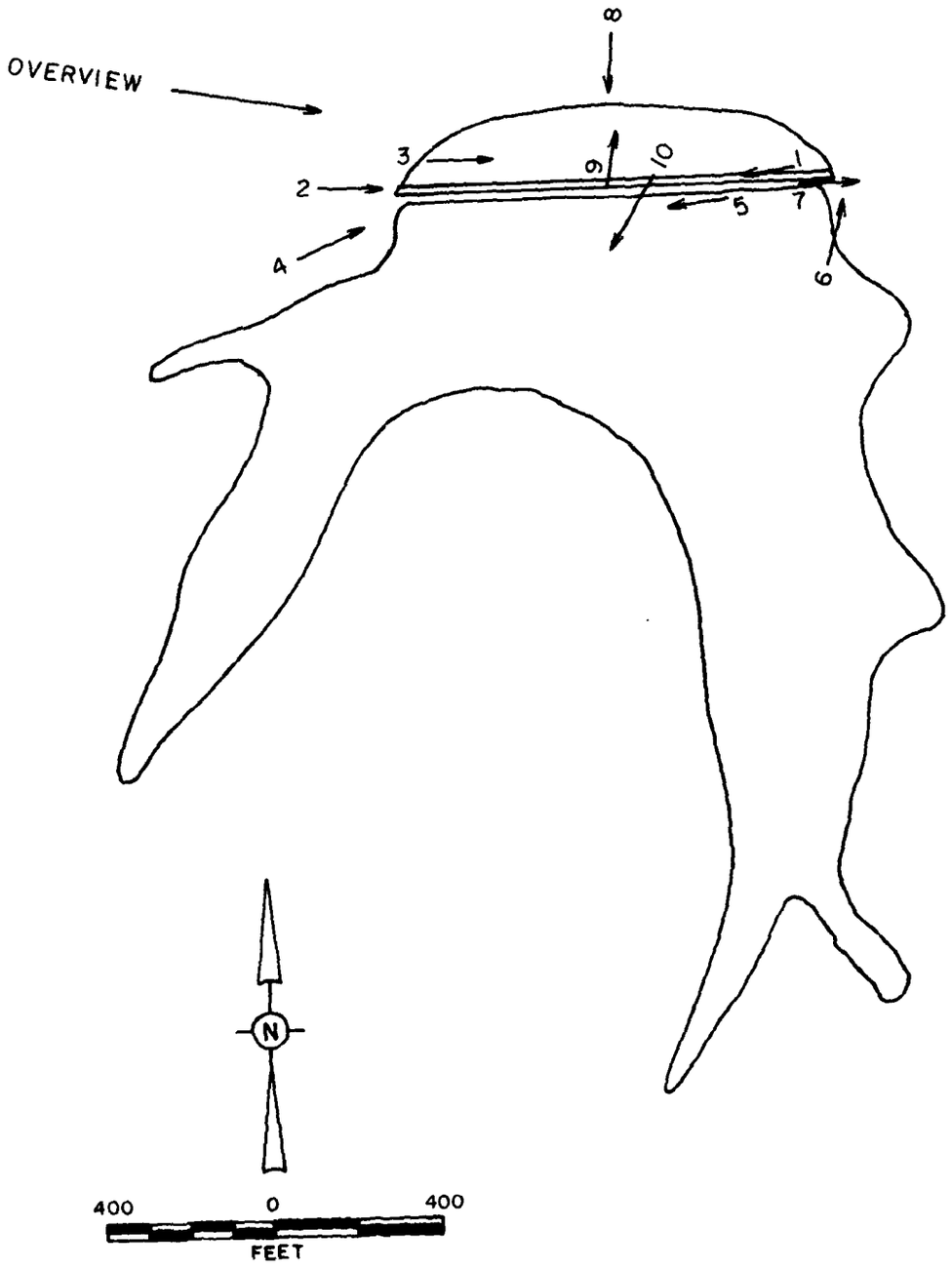


PHOTO INDEX
FOR
DEAL LAKE DAM

Deal Lake Dam

Photo 1. - View of the crest of the embankment.

Photo 2. - View of the crest of the embankment

Photo 3. - View of the downstream slope of the embankment.

Photo 4. - View of the upstream slope of the embankment.

Photo 5. - View of the erosion on the upstream slope.

Photo 6. - View of the emergency spillway crest on the left abutment.

Photo 7. - View of the emergency spillway crest.

Photo 8. - View of the outlet of the 12-inch discharge pipe.

Photo 9. - View of the downstream discharge channel.

Photo 10. - View of the reservior rim.

Photo 1

Photo 2

Photo 3

Photo 4

Deal Lake Dam

Photo 5

Photo 6

Photo 7

Photo 8

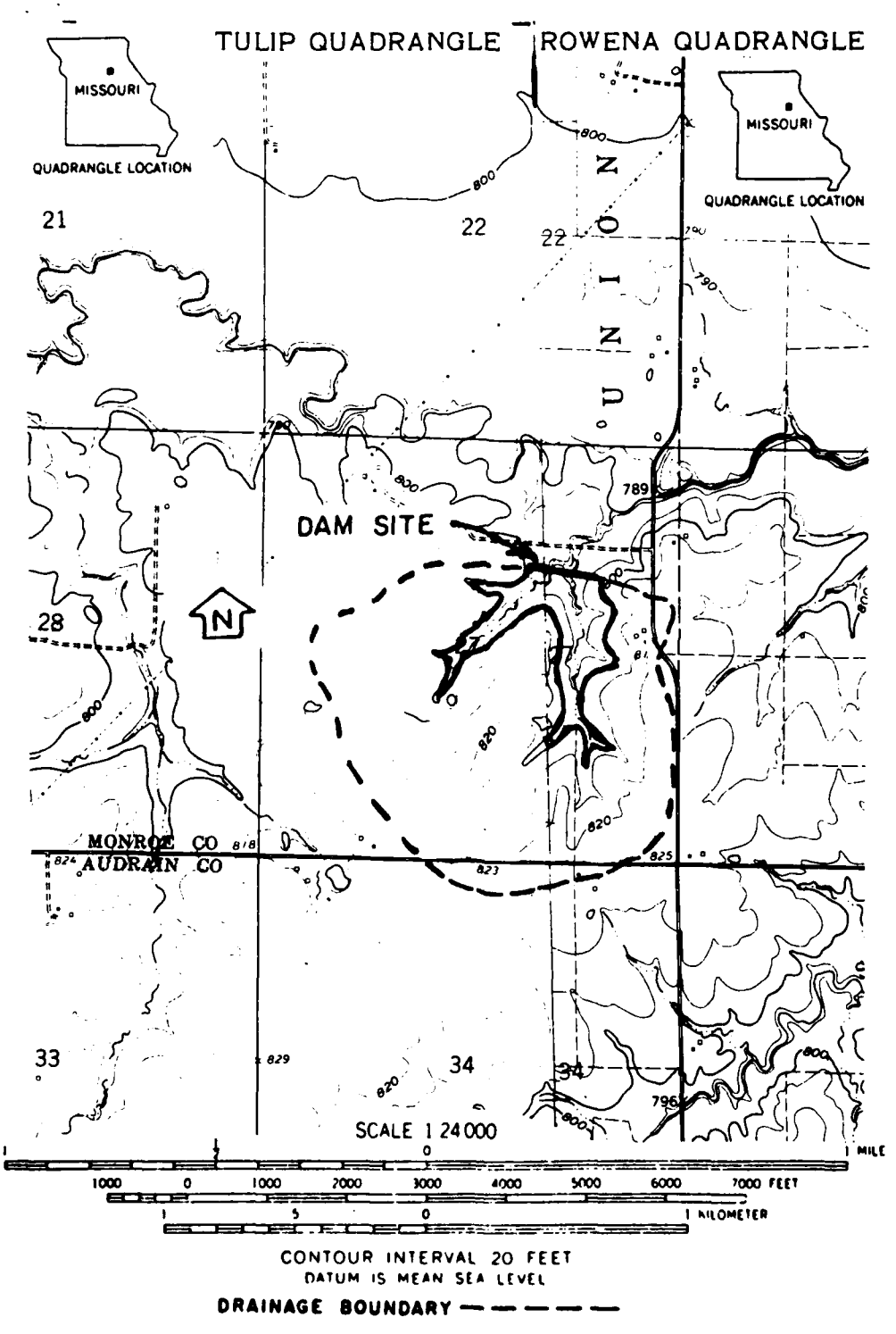
Deal Lake Dam

Photo 9

Photo 10

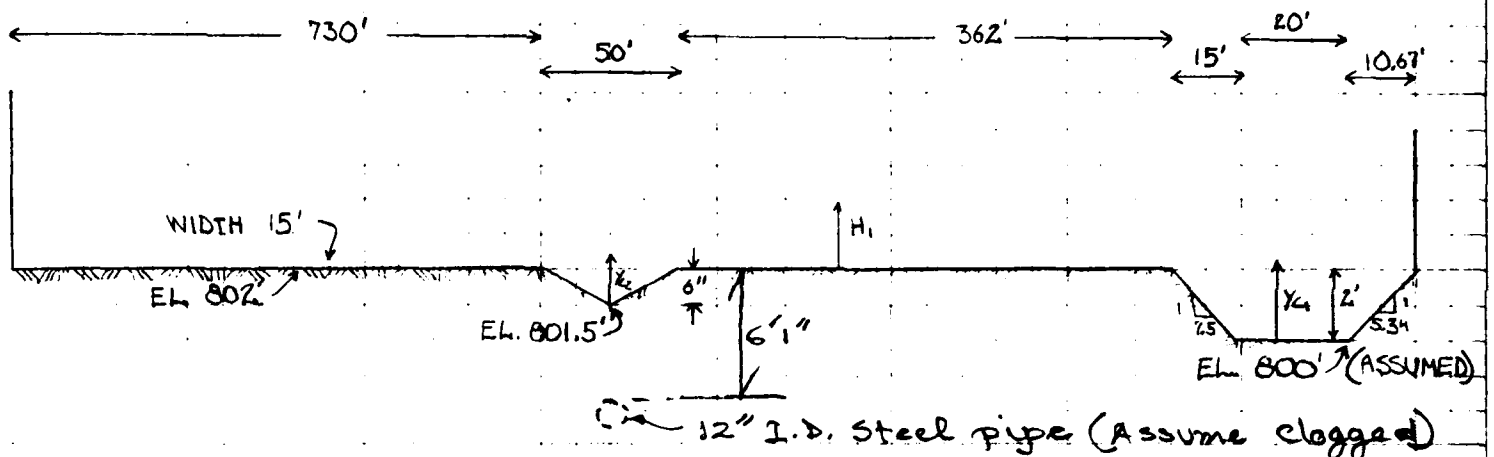
APPENDIX B

HYDROLOGIC COMPUTATIONS

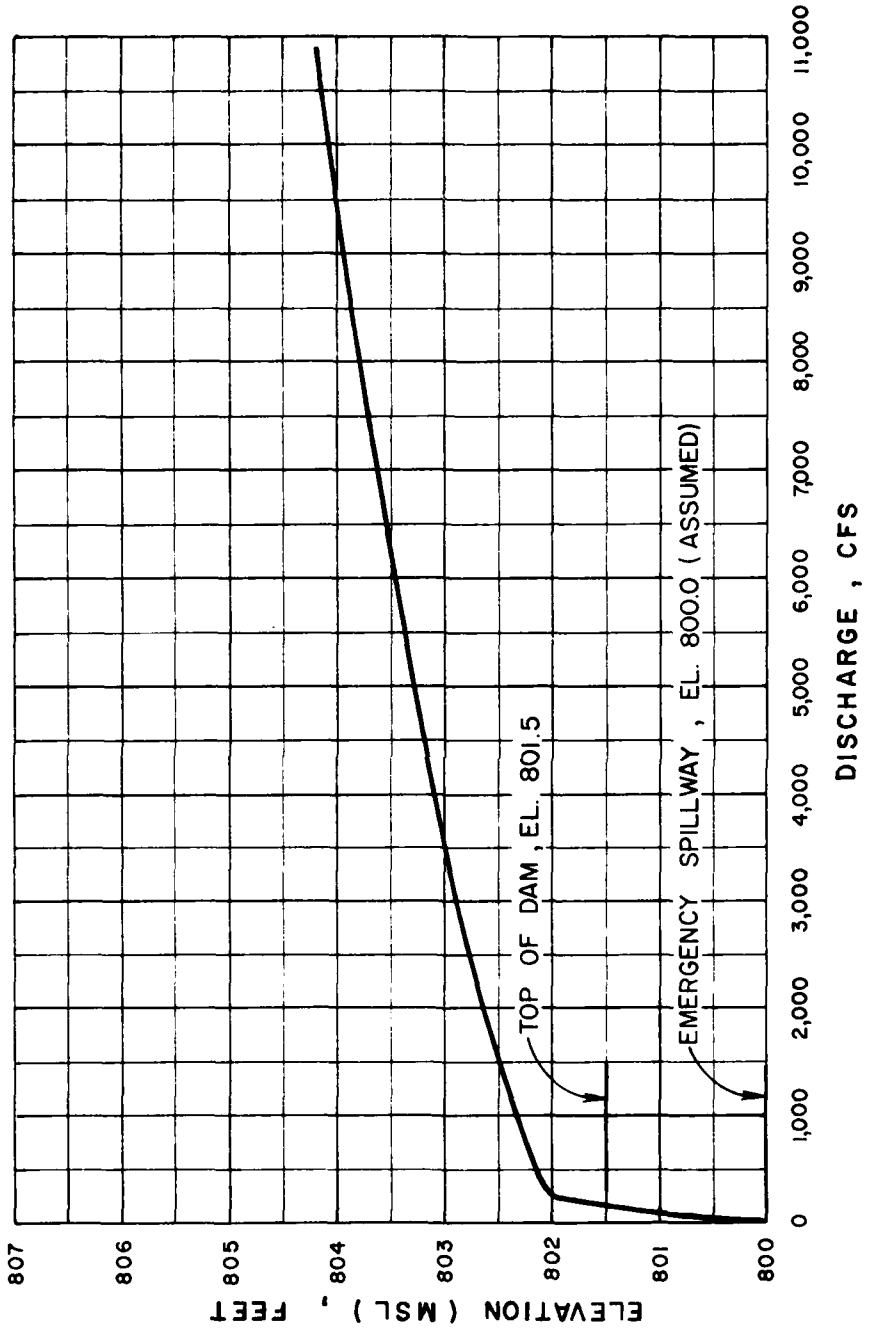


DEAL LAKE DAM (MO 10982)
DRAINAGE BASIN

DAM SAFETY INSPECTION - MISSOURI SHEET NO. 1 OF
DEAL LAKE DAM # MO. 10982 JOB NO. 1240
SPILLWAY AND OVERTOP RATING CURVE BY DNZ DATE 6/21/79



Y_{c_1}	A_{c_1}	T_{c_1}	$V_{c_1}=5.67\sqrt{\frac{A}{T}}$	$\frac{V_{c_1}^2}{2g}$	$Q_{c_1}=A_{c_1}V_{c_1}$	U.S W.S = $800+Y_{c_1}+\frac{V^2}{2g}$	Y_{c_2}	A_{c_2}	T_{c_2}	V_{c_2}	$Q_{c_2}=A_{c_2}V_{c_2}$	C_1	L_1	H_1	$Q_1=(C_1L_1H^{3/2})$	$Q_T=Q_{c_1}+Q_{c_2}+Q_1$
0	0	0	0	0	0	800	-	-	-	-	-	-	-	-	-	0
.5	11.60	26.4	3.76	0.22	43.6	800.72	-	-	-	-	-	-	-	-	-	44
1.0	26.92	32.84	5.09	0.40	134.4	801.40	-	-	-	-	-	-	-	-	-	134.
1.3	36.84	36.69	5.68	0.5	209.3	801.8	0.2	2.0	20	1.8	3.6	-	-	-	-	213
1.5	44.4	39.26	6.0	0.6	266.4	802.1	0.4	8.0	40	2.5	20.0	2.68	1092	.1	92.5	379
2.0	65.7	45.67	6.8	0.7	446.7	802.7	0.8	27.5	50	4.2	115.5	2.64	1092	.7	1538.	2251
2.5	88.5	45.67	7.9	1.0	698.7	803.5	1.3	52.5	50	5.8	305.0	2.64	1092	1.5	5276.2	6,300.
3.0	111.4	45.67	8.9	1.2	986.4	804.2	1.8	77.5	50	7.1	550.1	2.63	1092	2.2	7378.2	10,105



DEAL LAKE DAM (MO. 10982)
SPILLWAY & OVERTOP RATING CURVE

ECI-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION - MISSOURI SHEET NO. 1 OF 1

DEAL LAKE DAM (#10982) JOB NO. 1240

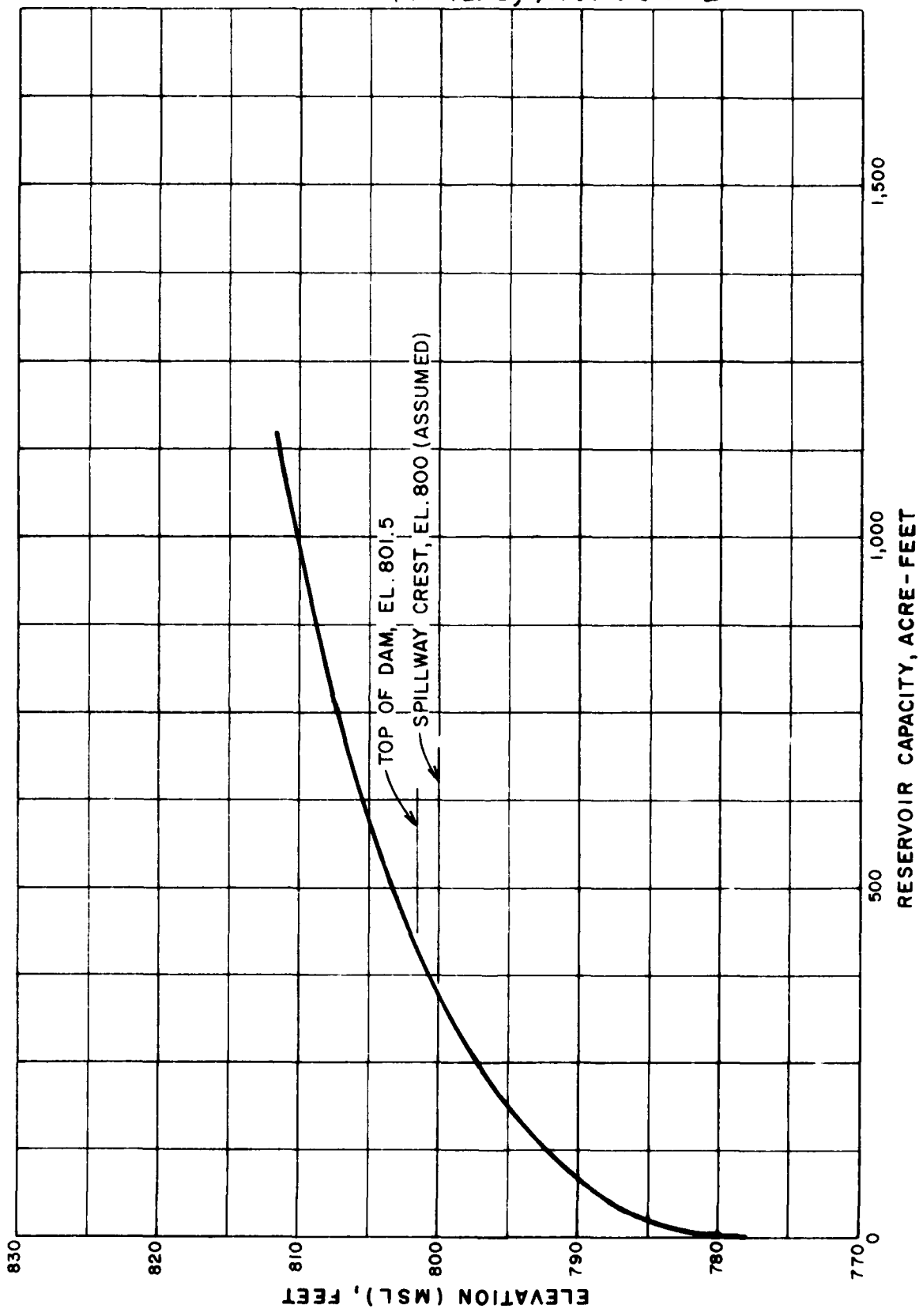
RESERVOIR AREA CAPACITY BY DNZ M.E.H. DATE 5/6/79

DAM # 10982

RESERVOIR AREA CAPACITY

ELEV. M.S.L. (FT)	RESERVOIR SURFACE AREA (ACRES)	INCREMENTAL VOLUME (AC-FT)	TOTAL VOLUME (AC-FT)	REMARKS
778	0	0	0	EST STREAMBED AT CTR. OF DAM
780	3.7	7.5	7.5	Area measured on USGS
790	14	83	86	Area measured on USGS
800	39	255	341	Water Surface (Est.) ASSUME SPILLWAY CREST
~~801.5~~	46	~~64~~	405	~~TOP~~ OF DAM
810	92	575	~~980~~	AREA MEASURED ON USGS MAP

PLATE-3, APPENDIX-B



DEAL LAKE DAM (MO. 10982)
RESERVOIR CAPACITY CURVE

DAM SAFETY INSPECTION - MISSOURI — SHEET NO. 1 OF
DEAL LAKE DAM # MO. 10982 — JOB NO. 1240
PROBABLE MAXIMUM PRECIPITATION — BY DNZ KLB DATE 6/11/79 6/22/79

DEAL LAKE DAM # MO. 10982

DETERMINATION OF PMP

1. DETERMINE DRAINAGE AREA OF THE BASIN

   D. A. = 361 ACRES

2. DETERMINE PMP INDEX RAINFALL (200 SQ MI & 24 HRS DUR)

   LOCATION OF CENTROID OF BASIN

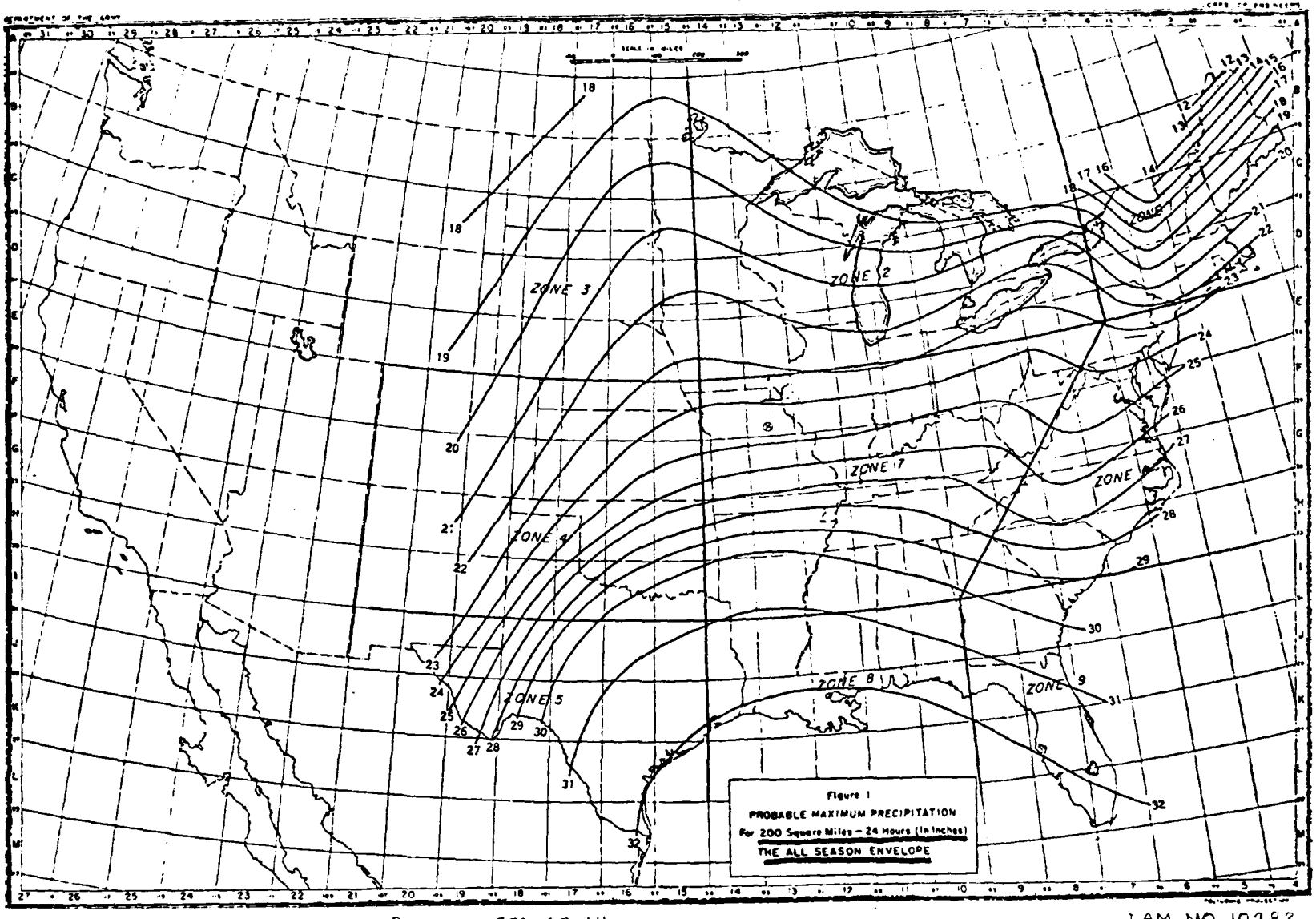
   LONG. = 92° 07' 38" LAT. = 39° 20' 43" PMP = 24.6"

3. DETERMINE BASIN RAINFALL IN TERMS OF PERCENTAGE OF PMP INDEX RAINFALL FOR VARIOUS DURATIONS :

   LOCATION LONG. = 92° 07' 38" LAT. = 39° 20' 43"

   ⇒ ZONE 7

DURATION (HRS)	PERCENT OF INDEX RAINFALL	TOTAL RAINFALL (IN.)	RAINFALL INCREMENTS	DURATION OF INCREMENTS
6	100	24.6	24.6	6
12	120	29.5	4.9	6
24	130	32.0	2.5	12



PMP FOR 200 SQ. MI
24 HRS DURATION = 24.6"

LAM NO. 10982
LOCATION OF CENTROID OF WATERSHED:
LAT 39°20'-3" LONG 92° W 38"

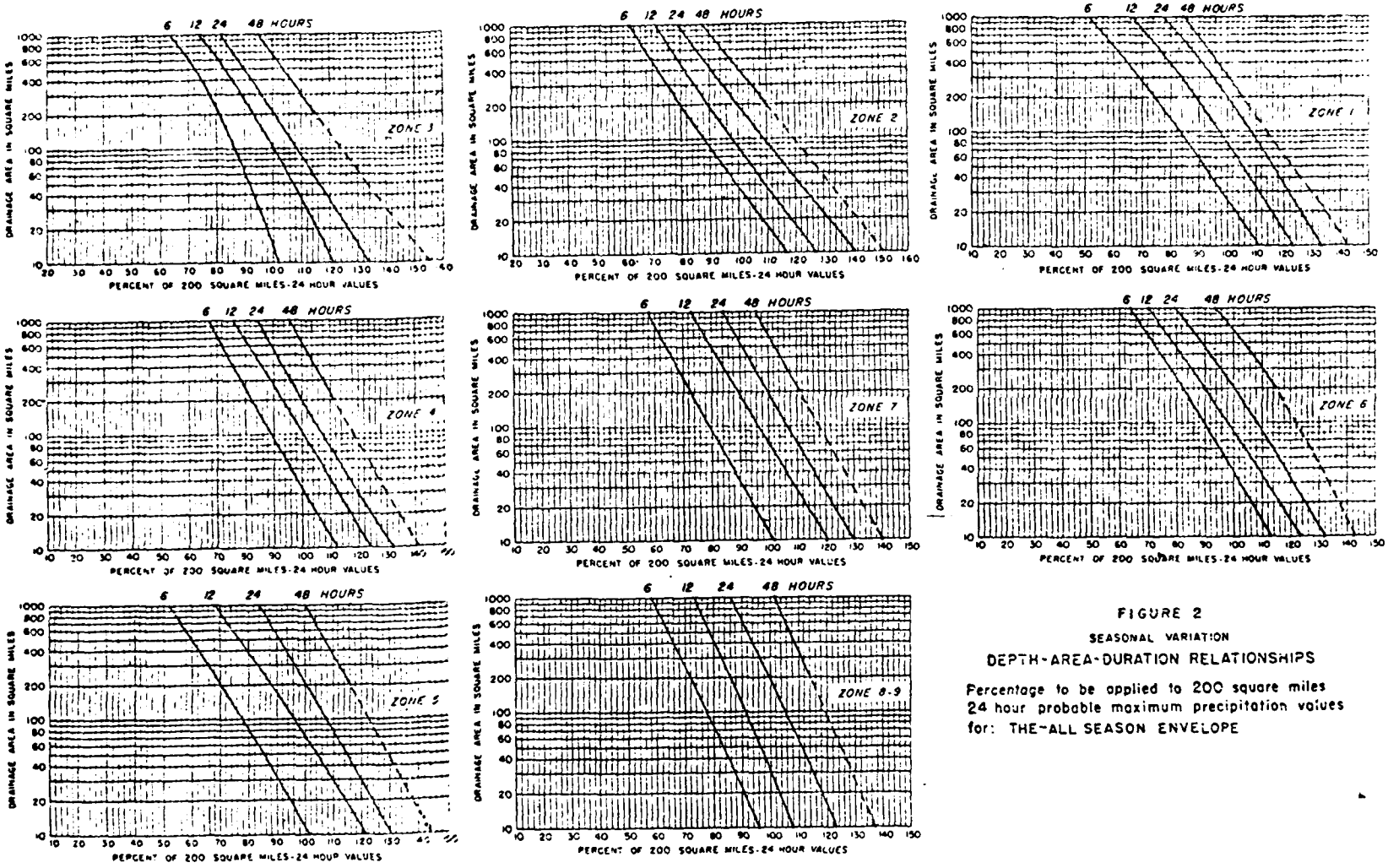


FIGURE 2

SEASONAL VARIATION

DEPTH-AREA-DURATION RELATIONSHIPS

Percentage to be applied to 200 square miles 24 hour probable maximum precipitation values for: THE-ALL SEASON ENVELOPE

ECI-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION - MISSOURI SHEET NO. 1 OF

DEAL LAKE DAM # MO. 10182 JOB NO. 1240

UNIT HYDROGRAPH PARAMETERS BY DNZ DATE 6/11/79

1. DRAINAGE AREA, $A = 361$ ACRES $= 0.56$ SQ. MI.

2. LENGTH OF STREAM, $L = 0.41$ MI $= 2165$ Ft.

3. ELEVATION AT DRAINAGE DIVIDE ALONG LONGEST STREAM

$H_1 = 825$ Ft

4. RESERVOIR ELEVATION AT SPILLWAY CREST, $H_2 = 800$

5. DIFFERENCE IN ELEVATION, $\Delta H = 25$ Ft

6. AVERAGE SLOPE OF STREAM $= \frac{\Delta H}{L} = \frac{25}{2165} = 1.2\%$

7. TIME OF CONCENTRATION:

a) BY KIRPICH FORMULA:

$$T_c = \left(\frac{11.9 \times L^3}{\Delta H}\right)^{0.385} = \left(\frac{11.9 \times 0.41^3}{25}\right)^{0.385} = 0.22 \text{ HR}$$

b) BY VELOCITY ESTIMATE: AVG. VEL = 2 FPS

$$T_c = \frac{L}{V} = \frac{2165}{2(60 \times 60)} = 0.30 \text{ HR}$$

USE $T_c = 0.27$ HR

8. LAG TIME, $L_t = 0.6 \times 0.27 = 0.16$ HR

9. UNIT DURATION, $D \leq \frac{L_t}{3} = \frac{0.16}{3} = 0.054 < 0.083$

USE $D = 0.083$ HR

10. TIME TO PEAK, $T_p = \frac{D}{2} + L_t = \frac{0.083}{2} + 0.16 = 0.20$ HR

11. PEAK DISCHARGE, $q_p = \frac{484 A}{T_p} = \frac{484 (0.56)}{0.20}$

$q_p = 1355$ CFS

DEAL LAKE DAM

DETERMINATION OF HYDROLOGIC SOIL GROUP & CURVE NUMBER

1. The watershed soils consist of primarily group 'D' soils.

2. Most of the watershed seem to be farm land with some forested areas. Assume the hydrologic condition of the watershed is "Fair"

   Thus CN = 86 for AMC-II & group 'D' soils

   $\Rightarrow$ CN = 94 for AMC-III

DEAL LAKE DAM

100-YR FLOOD BY REGRESSION EQUATION

REGRESSION EQUATION FOR 100-YR FLOOD FOR MISSOURI:

$$Q_{100} = 85.1\ A^{0.934\ A^{-0.02}}\ S^{0.576}$$

WHERE

A = DRAINAGE AREA IN SQ. MI.

S = MAIN CHANNEL SLOPE FT/MI.
(AVG. SLOPE BETWEEN 0.1L AND 0.85L)

FOR DEAL LAKE DAM:

A = 0.56 SQ. MI.

S = 65 FT/MI.

$$Q_{100} = (85.1)(0.56)^{0.934\ (0.56)^{-0.02}}\ (65)^{0.576}$$

Q_{100} = 545 CFS.

HEC1DB INPUT DATA

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  26 FEB 79
**********

     1          A                    DAM SAFETY INSPECTION - MISSOURI
     2          A                      DEAL LAKE DAM (10982)
     3          A                  PMF AND 50 PERCENT PMF DETERMINATION AND ROUTING
     4          B     300          1                    0    0    0    0    0    0    0
     5                1    4
     6               J     1    2         1
     7               J1    1    2.5
     8               K     0   10982
     9               X1   INPUT PRECIPITATION INDEX, RATIOS, AND UNIT HYDROGRAPH PARAMETERS
    10               P     1    2    3.06          0.56    1.0
    11               P          24.6     100      120     170
    12               T                                              -1     -94
    13               M2        0.16
    14               A     0    0    1
    15               M1    1   10982                    2    0    1
    16               X2   ROUTE HYDROGRAPH THROUGH DEAL LAKE DAM (10982)
    17               Y                          1    1
    18               Y1    1                                        -900     -1
    19               Y4   830   831.7   831.4   831.6   832.1   832.7   833.5   834.2
    20               Y5   0.0    54.    134.     13.     479.   2201.   6300.  10900.
    21               S5   0.0    2.5     26      341     485     580
    22               S    778    778     778     778     778     778
    23               S1   800
    24               S    801.5
    25               S     99
```

INFLOW PMF AND ONE-HALF PMF HYDROGRAPHS

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT [illegible] 1982
END OF NETWORK

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN DATE= 79/08/01.
TIME= 13.54.16.

                                    DAM SAFETY INSPECTION - MISSOURI
                                    DEAD LAKE DAM (10286)
                                    PMF AND 50 PERCENT PMF DETERMINATION AND ROUTING

                                    JOB SPECIFICATION
     NW     MAXMIN     NDAY     IDAY     LMT     IPRT     NSTAN     JPLT     JPRT     MSTAN
      0          0        1        0       0        0         0        0        0         0
                          JOPER     NWT    LROPT    TRACE
                              0       0        0

                                    MULTI-PLAN ANALYSES TO BE PERFORMED
                                    NPLAN= 1  NRTIO= 2  LRTIO= 1

                                    RTIOS=   1.00     .50

**********  **********  **********  **********  **********

                                    SUB-AREA RUNOFF COMPUTATION

                                    INPUT PRECIPITATION, LOSS, AND UNIT HYDROGRAPH PARAMETERS

                ITAPE    JPLT    JPRT    INAME    ISTAGE    IAUTO
                    0       0       0        1         0         0

                                    HYDROGRAPH DATA
            IHYDG    IUHG    GMAP    LOCAL    TRSDA    TRSPC    RATIO    ISNO    ISAME    LOCAL
                1       1    0.00        0     0.00     0.00     1.00   0.000        0        0

                                    PRECIP DATA
                      SPFE      PMS       R6      R12      R24      R48      R72      R96
                      0.00    24.00   100.00   120.00   135.00     0.00     0.00     0.00

                                    LOSS DATA
            LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRTP   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
                0    0.00    0.00    1.00    0.00    0.00    1.00  -1.00   -99.00    0.00    0.00

            # COPY NO = -99.00  WETNESS =  -1.00  EFFECT ON =  99.00

                                    UNIT HYDROGRAPH DATA
                                    TC=  0.10    LAG=  .10

                                    RECESSION DATA
                                    STRTQ=  0.00   QRCSN=   .00   RTIOR= 1.00

                                    TIME INCREMENT IN HYDROGRAPH=(ONE IS DT LAG/2)

                                    UNIT HYDROGRAPH 1 END OF PERIOD ORDINATES, LAG=  .10 VOL= 1.00
```

	446.	1.79.	1220.	698.	346.	177.	34.	46.	24.	13.			
	6.	1.											

END-OF-PERIOD FLOW

9 DA.MO	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.35	151	.21	.20	.00	870.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.40	152	.21	.20	.00	876.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.45	153	.21	.20	.00	880.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.50	154	.21	.20	.00	882.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.55	155	.21	.20	.00	883.
1.01	.30	6	.01	0.00	.01	0.	1.01	13.00	156	.21	.20	.00	883.
1.01	.35	7	.01	0.00	.01	0.	1.01	13.05	157	.25	.24	.00	902.
1.01	.40	8	.01	0.00	.01	0.	1.01	13.10	158	.25	.24	.00	954.
1.01	.45	9	.01	0.00	.01	0.	1.01	13.15	159	.25	.24	.00	1004.
1.01	.50	10	.01	.00	.01	0.	1.01	13.20	160	.25	.24	.00	1032.
1.01	.55	11	.01	.00	.01	0.	1.01	13.25	161	.25	.24	.00	1047.
1.01	1.00	12	.01	.00	.01	2.	1.01	13.30	162	.25	.25	.00	1054.
1.01	1.05	13	.01	.00	.01	3.	1.01	13.35	163	.25	.25	.00	1058.
1.01	1.10	14	.01	.00	.01	5.	1.01	13.40	164	.25	.25	.00	1060.
1.01	1.15	15	.01	.00	.01	7.	1.01	13.45	165	.25	.25	.00	1061.
1.01	1.20	16	.01	.00	.01	9.	1.01	13.50	166	.25	.25	.00	1062.
1.01	1.25	17	.01	.00	.01	11.	1.01	13.55	167	.25	.25	.00	1063.
1.01	1.30	18	.01	.00	.01	13.	1.01	14.00	168	.25	.25	.00	1063.
1.01	1.35	19	.01	.00	.01	14.	1.01	14.05	169	.31	.31	.00	1090.
1.01	1.40	20	.01	.00	.01	15.	1.01	14.10	170	.31	.31	.00	1169.
1.01	1.45	21	.01	.00	.01	[illegible]	1.01	14.15	171	.31	.31	.00	1244.
1.01	1.50	22	.01	.01	.01	19.	1.01	14.20	172	.31	.31	.00	1286.
1.01	1.55	23	.01	.01	.01	[illegible]	1.01	14.25	173	.31	.31	.00	1307.
1.01	2.00	24	.01	.01	.01	[illegible]	1.01	14.30	174	.31	.31	.00	1319.
1.01	2.05	25	.01	.01	.01	23.	1.01	14.35	175	.31	.31	.00	1324.
1.01	2.10	26	.01	.01	.01	24.	1.01	14.40	176	.31	.31	.00	1327.
1.01	2.15	27	.01	.01	.01	[illegible]	1.01	14.45	177	.31	.31	.00	1329.
1.01	2.20	28	.01	.01	.01	[illegible]	1.01	14.50	178	.31	.31	.00	1330.
1.01	2.25	29	.01	.01	.01	[illegible]	1.01	14.55	179	.31	.31	.00	1330.
1.01	2.30	30	.01	.01	.01	[illegible]	1.01	15.00	180	.31	.31	.00	1330.
1.01	2.35	31	.01	.01	.01	29.	1.01	15.05	181	.19	.19	.00	1277.
1.01	2.40	32	.01	.01	.01	30.	1.01	15.10	182	.37	.37	.00	1206.
1.01	2.45	33	.01	.01	.01	[illegible]	1.01	15.15	183	.37	.37	.00	1298.
1.01	2.50	34	.01	.01	.01	32.	1.01	15.20	184	.65	.65	.00	1527.
1.01	2.55	35	.01	.01	.01	33.	1.01	15.25	185	.65	.65	.00	1894.
1.01	3.00	36	.01	.01	.01	[illegible]	1.01	15.30	186	1.59	1.59	.00	2703.
1.01	3.05	37	.01	.01	.01	34.	1.01	15.35	187	2.62	2.61	.00	4621.
1.01	3.10	38	.01	.01	.01	35.	1.01	15.40	188	1.63	1.63	.00	6503.
1.01	3.15	39	.01	.01	.01	[illegible]	1.01	15.45	189	.65	.65	.00	6271.
1.01	3.20	40	.01	.01	.01	[illegible]	1.01	15.50	190	.56	.56	.00	4879.
1.01	3.25	41	.01	.01	.00	37.	1.01	15.55	191	.37	.37	.00	3672.
1.01	3.30	42	.01	.01	.00	37.	1.01	16.00	192	.37	.37	.00	2790.
1.01	3.35	43	.01	.01	.00	38.	1.01	16.05	193	.29	.29	.00	2189.
1.01	3.40	44	.01	.01	.00	[illegible]	1.01	16.10	194	.29	.29	.00	1780.
1.01	3.45	45	.01	.01	.00	39.	1.01	16.15	195	.29	.29	.00	1522.
1.01	3.50	46	.01	.01	.00	[illegible]	1.01	16.20	196	.29	.29	.00	1386.
1.01	3.55	47	.01	.01	.00	40.	1.01	16.25	197	.29	.29	.00	1312.
1.01	4.00	48	.01	.01	.00	41.	1.01	16.30	198	.29	.29	.00	1272.
1.01	4.05	49	.01	.01	.00	41.	1.01	16.35	199	.29	.29	.00	1255.
1.01	4.10	50	.01	.01	.00	41.	1.01	16.40	200	.29	.29	.00	1248.
1.01	4.15	51	.01	.01	.00	42.	1.01	16.45	201	.28	.28	.00	1245.
1.01	4.20	52	.01	.01	.00	42.	1.01	16.50	202	.29	.29	.00	1244.
1.01	4.25	53	.01	.01	.00	42.	1.01	16.55	203	.29	.29	.00	1243.
1.01	4.30	54	.01	.01	.00	43.	1.01	17.00	204	.29	.29	.00	1243.

1.01	4.35	55	.01	.01	.00	43.	1.01	17.05	205	.23	.23	.00	1216.
1.01	4.40	56	.01	.01	.00	44.	1.01	17.10	206	.23	.23	.00	1137.
1.01	4.45	57	.01	.01	.00	44.	1.01	17.15	207	.23	.23	.00	1062.
1.01	4.50	58	.01	.01	.00	44.	1.01	17.20	208	.23	.23	.00	1020.
1.01	4.55	59	.01	.01	.00	45.	1.01	17.25	209	.23	.23	.00	999.
1.01	5.00	60	.01	.01	.00	45.	1.01	17.30	210	.23	.23	.00	988.
1.01	5.05	61	.01	.01	.00	45.	1.01	17.35	211	.23	.23	.00	982.
1.01	5.10	62	.01	.01	.00	45.	1.01	17.40	212	.23	.23	.00	980.
1.01	5.15	63	.01	.01	.00	46.	1.01	17.45	213	.23	.23	.00	978.
1.01	5.20	64	.01	.01	.00	46.	1.01	17.50	214	.23	.23	.00	977.
1.01	5.25	65	.01	.01	.00	46.	1.01	17.55	215	.23	.23	.00	977.
1.01	5.30	66	.01	.01	.00	46.	1.01	18.00	216	.23	.23	.00	977.
1.01	5.35	67	.01	.01	.00	47.	1.01	18.05	217	.02	.02	.00	885.
1.01	5.40	68	.01	.01	.00	47.	1.01	18.10	218	.02	.02	.00	493.
1.01	5.45	69	.01	.01	.00	47.	1.01	18.15	219	.02	.02	.00	373.
1.01	5.50	70	.01	.01	.00	47.	1.01	18.20	220	.02	.02	.00	233.
1.01	5.55	71	.01	.01	.00	48.	1.01	18.25	221	.02	.02	.00	162.
1.01	6.00	72	.01	.01	.00	48.	1.01	18.30	222	.02	.02	.00	126.
1.01	6.05	73	.07	.06	.01	68.	1.01	18.35	223	.02	.02	.00	107.
1.01	6.10	74	.07	.06	.01	127.	1.01	18.40	224	.02	.02	.00	98.
1.01	6.15	75	.07	.06	.01	184.	1.01	18.45	225	.02	.02	.00	93.
1.01	6.20	76	.07	.06	.01	217.	1.01	18.50	226	.02	.02	.00	90.
1.01	6.25	77	.07	.06	.01	236.	1.01	18.55	227	.02	.02	.00	89.
1.01	6.30	78	.07	.06	.01	247.	1.01	19.00	228	.02	.02	.00	89.
1.01	6.35	79	.07	.06	.01	254.	1.01	19.05	229	.02	.02	.00	89.
1.01	6.40	80	.07	.06	.01	259.	1.01	19.10	230	.02	.02	.00	89.
1.01	6.45	81	.07	.06	.01	262.	1.01	19.15	231	.02	.02	.00	89.
1.01	6.50	82	.07	.06	.01	264.	1.01	19.20	232	.02	.02	.00	89.
1.01	6.55	83	.07	.06	.01	266.	1.01	19.25	233	.02	.02	.00	89.
1.01	7.00	84	.07	.06	.01	268.	1.01	19.30	234	.02	.02	.00	89.
1.01	7.05	85	.07	.06	.01	271.	1.01	19.35	235	.02	.02	.00	89.
1.01	7.10	86	.07	.06	.01	273.	1.01	19.40	236	.02	.02	.00	89.
1.01	7.15	87	.07	.06	.01	274.	1.01	19.45	237	.02	.02	.00	89.
1.01	7.20	88	.07	.06	.01	275.	1.01	19.50	238	.02	.02	.00	89.
1.01	7.25	89	.07	.06	.00	276.	1.01	19.55	239	.02	.02	.00	89.
1.01	7.30	90	.07	.06	.00	277.	1.01	20.00	240	.02	.02	.00	89.
1.01	7.35	91	.07	.06	.00	278.	1.01	20.05	241	.02	.02	.00	89.
1.01	7.40	92	.07	.06	.00	279.	1.01	20.10	242	.02	.02	.00	89.
1.01	7.45	93	.07	.07	.00	280.	1.01	20.15	243	.02	.02	.00	89.
1.01	7.50	94	.07	.07	.00	281.	1.01	20.20	244	.02	.02	.00	89.
1.01	7.55	95	.07	.07	.00	282.	1.01	20.25	245	.02	.02	.00	89.
1.01	8.00	96	.07	.07	.00	282.	1.01	20.30	246	.02	.02	.00	89.
1.01	8.05	97	.07	.07	.00	283.	1.01	20.35	247	.02	.02	.00	89.
1.01	8.10	98	.07	.07	.00	283.	1.01	20.40	248	.02	.02	.00	89.
1.01	8.15	99	.07	.07	.00	284.	1.01	20.45	249	.02	.02	.00	89.
1.01	8.20	100	.07	.07	.00	285.	1.01	20.50	250	.02	.02	.00	89.
1.01	8.25	101	.07	.07	.00	285.	1.01	20.55	251	.02	.02	.00	89.
1.01	8.30	102	.07	.07	.00	285.	1.01	21.00	252	.02	.02	.00	89.
1.01	8.35	103	.07	.07	.00	286.	1.01	21.05	253	.02	.02	.00	89.
1.01	8.40	104	.07	.07	.00	286.	1.01	21.10	254	.02	.02	.00	89.
1.01	8.45	105	.07	.07	.00	287.	1.01	21.15	255	.02	.02	.00	89.
1.01	8.50	106	.07	.07	.00	287.	1.01	21.20	256	.02	.02	.00	89.
1.01	8.55	107	.07	.07	.00	287.	1.01	21.25	257	.02	.02	.00	89.
1.01	9.00	108	.07	.07	.00	288.	1.01	21.30	258	.02	.02	.00	89.
1.01	9.05	109	.07	.07	.00	288.	1.01	21.35	259	.02	.02	.00	89.
1.01	9.10	110	.07	.07	.00	288.	1.01	21.40	260	.02	.02	.00	89.
1.01	9.15	111	.07	.07	.00	289.	1.01	21.45	261	.02	.02	.00	89.
1.01	9.20	112	.07	.07	.00	289.	1.01	21.50	262	.02	.02	.00	89.
1.01	9.25	113	.07	.07	.00	289.	1.01	21.55	263	.02	.02	.00	89.
1.01	9.30	114	.07	.07	.00	289.	1.01	22.00	264	.02	.02	.00	89.

1.01	9.35	115	.07	.07	.00	289.	1.01	22.05	265	.02	.02	.00	89.
1.01	9.40	116	.07	.07	.00	[illegible]	1.01	22.10	266	.02	.02	.00	89.
1.01	9.45	117	.07	.07	.00	290.	1.01	22.15	267	.02	.02	.00	89.
1.01	9.50	118	.07	.07	.00	290.	1.01	22.20	268	.02	.02	.00	89.
1.01	9.55	119	.07	.07	.00	290.	1.01	22.25	269	.02	.02	.00	89.
1.01	10.00	120	.07	.07	.00	290.	1.01	22.30	270	.02	.02	.00	89.
1.01	10.05	121	.07	.07	.00	291.	1.01	22.35	271	.02	.02	.00	89.
1.01	10.10	122	.07	.07	.00	291.	1.01	22.40	272	.02	.02	.00	89.
1.01	10.15	123	.07	.07	.00	291.	1.01	22.45	273	.02	.02	.00	89.
1.01	10.20	124	.07	.07	.00	291.	1.01	22.50	274	.02	.02	.00	89.
1.01	10.25	125	.07	.07	.00	291.	1.01	22.55	275	.02	.02	.00	89.
1.01	10.30	126	.07	.07	.00	291.	1.01	23.00	276	.02	.02	.00	89.
1.01	10.35	127	.07	.07	.00	291.	1.01	23.05	277	.02	.02	.00	89.
1.01	10.40	128	.07	.07	.00	292.	1.01	23.10	278	.02	.02	.00	89.
1.01	10.45	129	.07	.07	.00	292.	1.01	23.15	279	.02	.02	.00	89.
1.01	10.50	130	.07	.07	.00	292.	1.01	23.20	280	.02	.02	.00	89.
1.01	10.55	131	.07	.07	.00	292.	1.01	23.25	281	.02	.02	.00	89.
1.01	11.00	132	.07	.07	.00	292.	1.01	23.30	282	.02	.02	.00	89.
1.01	11.05	133	.07	.07	.00	292.	1.01	23.35	283	.02	.02	.00	89.
1.01	11.10	134	.07	.07	.00	292.	1.01	23.40	284	.02	.02	.00	89.
1.01	11.15	135	.07	.07	.00	292.	1.01	23.45	285	.02	.02	.00	89.
1.01	11.20	[illegible]	.07	.07	.	293.	1.01	23.50	286	.02	.02	.00	89.
1.01	11.25	137	.07	.07	.	293.	1.01	23.55	287	.02	.02	.00	89.
1.01	11.30	138	.07	.07	.00	293.	1.02	0.00	288	.02	.02	.00	89.
1.01	11.35	139	.07	.07	.00	294.	1.02	.05	289	0.00	0.00	0.00	80.
1.01	11.40	140	.07	.07	.00	29[illegible].	1.02	.10	290	0.00	0.00	0.00	53.
1.01	11.45	141	.07	.07	.00	[illegible]	1.02	.15	291	0.00	0.00	0.00	28.
1.01	11.50	142	.07	.07	.00	295.	1.02	.20	292	0.00	0.00	0.00	14.
1.01	11.55	143	.07	.07	.00	29[illegible].	1.02	.25	293	0.00	0.00	0.00	7.
1.01	12.00	144	.07	.07	.00	29[illegible].	1.02	.30	294	0.00	0.00	0.00	4.
1.01	12.05	145	.21	.20	.00	354.	1.02	.35	295	0.00	0.00	0.00	2.
1.01	12.10	146	.	.20	.	527.	1.02	.40	296	0.00	0.00	0.00	1.
1.01	12.15	147	.21	.	.	682.	1.02	.45	297	0.00	0.00	0.00	0.
1.01	12.20	148	.21	.20	.00	785.	1.02	.50	298	0.00	0.00	0.00	0.
1.01	12.25	149	.21	.20	.00	837.	1.02	.55	299	0.00	0.00	0.00	0.
1.01	12.30	150	.21	.20	.00	857.	1.02	1.00	300	0.00	0.00	0.00	0.

SUM 31.98 31.23 .75 135350.
(812.)(793.)(19.)(3832.69)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6303.	1466.	470.	451.	135348.
CMS	184.	42.	13.	13.	3833.
INCHES		24.39	31.23	31.23	31.27
MM		619.58	793.15	793.15	793.1[illegible]
AC-FT		727.	932.	932.	932.
THOUS CU M		896.	1150.	1150.	1150.

HYDROGRAPH AT STA [illegible]982 FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	2.	3.	5.	7.	9.	11.	13.	14.	16.
18.	19.	2[illegible].	2[illegible].	23.	24.	2[illegible].	2[illegible].	27.	28.
29.	30.	31.	32.	33.	33.	34.	3[illegible].	35.	36.
37.	37.	38.	38.	[illegible]	39.	40.	40.	41.	41.
42.	42.	42.	43.	43.	44.	44.	44.	45.	45.
45.	45.	46.	46.	46.	46.	47.	47.	47.	47.
4[illegible].	48.	[illegible]	127.	164.	217.	236.	247.	254.	259.
263.	265.	268.	269.	271.	273.	274.	275.	276.	277.

278.	279.	280.	281.	282.	282.	283.	283.	284.	285.
285.	28[illegible]	28[illegible]	28[illegible]	287.	287.	287.	288.	288.	268.
289.	[illegible]	[illegible]	[illegible]	[illegible]	290.	290.	290.	290.	290.
291.	291.	291.	291.	291.	291.	291.	292.	292.	292.
292.	[illegible]2.	292.	292.	292.	292.	293.	293.	2[illegible]3.	293.
[illegible]	2[illegible]	293.	293.	354.	527.	692.	785.	833.	957.
670.	87[illegible]	[illegible]	682.	863.	683.	902.	954.	1004.	1032.
1047.	1054.	1[illegible]	1060.	1061.	1[illegible]2.	1063.	1063.	1070.	1169.
1244.	126[illegible]	130[illegible]	1317.	1324.	1327.	1329.	1330.	1330.	1330.
1277.	[illegible]	[illegible]48.	1527.	1494.	2703.	4621.	6503.	6271.	4879.
7672.	2794.	1179.	1780.	[illegible]	1366.	1312.	1272.	1255.	1248.
1245.	1244.	124[illegible]	1243.	1216.	1137.	1062.	1000.	999.	988.
992.	980.	[illegible]	977.	977.	977.	935.	623.	373.	233.
162.	120.	137.	96.	93.	91.	89.	89.	69.	69.
89.	[illegible]	[illegible]	[illegible]	90.	95.	83.	89.	89.	89.
89.	89.	[illegible]	89.	[illegible]	89.	89.	89.	89.	99.
90.	89.	[illegible]	85.	89.	89.	89.	85.	89.	99.
85.	99.	[illegible]	[illegible]	89.	89.	99.	99.	87.	89.
89.	89.	89.	89.	99.	89.	69.	69.	89.	89.
99.	89.	99.	86.	89.	65.	69.	89.	80.	53.
28.	14.	7.	4.	2.	1.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6593.	1466.	471.	451.	135348.
CMS	187.	42.	13.	13.	3833.
INCHES		24.35	31.23	31.23	31.23
MM		618.[illegible]	793.15	797.16	793.16
AC-FT		727.	932.	932.	932.
THOUS CU M		896.	1150.	1150.	1150.

HYDROGRAPH AT STA 1[illegible] FOR PLAN 1, RTIO 2

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	[illegible]	3.	[illegible]	4.	[illegible]	[illegible]	7.	8.
9.	9.	10.	11.	11.	12.	13.	13.	14.	14.
15.	15.	1[illegible]	1[illegible]	16.	17.	17.	17.	18.	18.
18.	19.	19.	19.	19.	20.	20.	20.	20.	21.
21.	21.	21.	21.	[illegible]	22.	22.	22.	22.	22.
23.	23.	23.	23.	[illegible]	23.	23.	23.	24.	24.
24.	24.	24.	43.	92.	10[illegible]	110.	124.	127.	130.
131.	133.	134.	135.	136.	136.	137.	138.	138.	139.
139.	14[illegible]	140.	140.	141.	141.	141.	142.	142.	142.
143.	143.	143.	143.	14[illegible]	144.	144.	144.	144.	144.
144.	144.	145.	145.	145.	145.	145.	145.	145.	145.
145.	145.	145.	146.	146.	146.	146.	146.	146.	146.
146.	146.	146.	146.	146.	146.	146.	146.	146.	146.
146.	146.	147.	147.	177.	263.	346.	393.	416.	428.
435.	438.	440.	441.	441.	442.	451.	477.	502.	516.
523.	527.	529.	530.	531.	531.	531.	531.	535.	584.
622.	643.	654.	[illegible]	662.	664.	664.	665.	665.	665.
638.	583.	[illegible]	7[illegible]	947.	1751.	2510.	3252.	3135.	2439.
1836.	1395.	1095.	890.	7[illegible]1.	693.	656.	636.	628.	621.
695.	622.	[illegible]	622.	[illegible]	[illegible]	531.	610.	459.	494.
491.	490.	485.	469.	48[illegible]	480.	448.	312.	187.	116.
81.	63.	54.	4[illegible]	46.	45.	44.	44.	44.	44.
40.	44.	44.	44.	44.	44.	44.	44.	44.	44.
44.	44.	44.	44.	44.	44.	44.	44.	44.	44.
44.	44.	44.	44.	44.	44.	44.	44.	44.	44.
44.	44.	44.	44.	44.	44.	44.	44.	44.	44.

44.	44.	44.	44.	44.	44.	44.	44.	44.	44.	44.
44.	44.	44.	44.	44.	44.	44.	44.	44.	41.	27.
14.	7.	4.	2.	1.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
	1351.	735.	23.	23.	6767.
	92.	24.	7.	5.	1910.
		1[illegible]	1[illegible]	1[illegible]	1[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]
		466.	466.	466.	466.
		443.	575.	575.	575.

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH DEAD LAKE DAM (1U=02)

ITAPE	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1[illegible]	1	0	0	2	0	1	0	0

ROUTING DATA

CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.	0.060	1	1		1	0

NSTPS	NSTPL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1		0	0.000	0.000	0.000	-2[illegible].	-1

[illegible].	[illegible].	[illegible].	801.49	801.82	802.10	802.37	803.50	804.20
PLT	0.00	44.00	134.00	213.00	379.00	2251.00	6300.00	10905.00
CAPACITY=	0.	0.	[illegible].	341.	405.	980.		
ELEVATION=	778.	780.	790.	[illegible].	802.	810.		

APLL	SPLIT	LOSS	EXPK	ELEVL	CODL	CAREA	EXPL
[illegible].	0.	0.0	0.0	0.	0.0	0.0	0.0

DAM DATA

TOPEL	COQL	EXPD	DAMWID
801.5	0.0	0.0	0.

STATION 10[illegible], PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	2.	2.	2.	3.	3.
3.	3.	4.	4.	4.	4.	5.	5.	5.	6.
6.	6.	6.	7.	7.	7.	8.	8.	8.	9.
9.	9.	10.	10.	10.	11.	11.	11.	12.	12.
12.	12.	13.	13.	14.	14.	14.	15.	15.	15.
15.	16.	16.	17.	19.	20.	22.	24.	27.	29.
31.	33.	35.	38.	41.	42.	46.	50.	55.	60.

SUMMARY OF PMF AND ONE-HALF PMF FLOOD ROUTING

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2
				1.00	.50
HYDROGRAPH AT	1096	.05	1	6503.	3252.
		(1.45)		(184.15)	(92.07)
ROUTED TO	1092	.05	1	5172.	2222.
		(1.45)		(147.57)	(62.93)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	800.00	800.00	801.50
STORAGE	341.	341.	405.
OUTFLOW	0.	0.	154.

RATIO OF PMF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	803.26	1.76	524.	5070.	13.08	15.83	0.00
.50	802.60	1.10	486.	2922.	8.33	15.83	0.00

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 10982.
ROUTE HYDROGRAPH TO 10982
END OF NETWORK

PERCENT OF PMF FLOOD ROUTING
EQUAL TO SPILLWAY CAPACITY

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 5 FEB 79

RUN DATE= 79/08/21.
TIME= 13.57.22.

DAM SAFETY INSPECTION - MISSOURI
CAL LAKE DAM (MO9-2)
PERCENT OF PRECIPITATION AND ROUTING

JOB SPECIFICATION

NO	NW	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
500	0		0	0	0	0	4	0

JOPER	NRT	LROPT	TRACE
	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIOS= 9 LRTIOS= 1

RTIOS= .10 .11 .12 .13 .14 .15 .16 .17 .18

SUB-AREA RUNOFF COMPUTATION

INPUT PRECIPITATION, INDEX, RATIOS, AND UNIT HYDROGRAPH PARAMETERS

ITAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	1	0	0	0	0	0	0	0

HYDROGRAPH DATA

IHYD	HUNIT	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISAME	LOCAL
1	1	.06	0.00	.50	1.00	0.000	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.60	100.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOS	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-99.00	0.00	0.00

CURVE NO = -99.00 HSTRSS = -1.00 EFFECT CN = 99.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .10

RECESSION DATA

STRTQ= .0 QRCSN= 0.00 RTIOR=1.00

END-OF-PERIOD FLOW

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM 71.48 31.25 .75 195580.
(412.) (79.) (19.91 38(2.69)

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH DEAL LAKE DAM (109AC)

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
19432	1	0	0		0	0	0	0

ROUTING DATA

JLOSS	CLOSS	AVG	IRES	ISAME	ICPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	1

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.100	0.000	=803.	-1

ELAGE	800.00	800.72	801.49	801.80	802.10	802.70	803.50	804.20
FLOW	0.00	44.00	134.00	213.00	574.00	2251.00	6300.00	10965.00
CAPACITY=	0.	7.	96.	341.	435.	980.		
ELEVATION=	778.	779.	799.	800.	801.	810.		

CREL	SPILW	CLSW	EXPW	ELEVL	COOL	CAREA	EXPL
0.0+0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
801.5	1.0	0.0	0.

PEAK OUTFLOW IS 112. AT TIME 17.17 HOURS

PEAK OUTFLOW IS 127. AT TIME 17.17 HOURS

PEAK OUTFLOW IS 143. AT TIME 17.08 HOURS

PEAK OUTFLOW IS 160. AT TIME 17.08 HOURS

PEAK OUTFLOW IS 175. AT TIME 17.00 HOURS

PEAK OUTFLOW IS 189. AT TIME 17.00 HOURS

PEAK OUTFLOW IS 198. AT TIME 17.00 HOURS

PEAK OUTFLOW IS 211. AT TIME 17.00 HOURS

PEAK OUTFLOW IS 238. AT TIME 16.42 HOURS

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B-30

PEAK FLOW AND STORAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .10	RATIO 2 .11	RATIO 3 .12	RATIO 4 .13	RATIO 5 .14	RATIO 6 .15	RATIO 7 .16	RATIO 8 .17	RATIO 9 .18
HYDROGRAPH AT	1	.52	1	650.	715.	780.	845.	910.	975.	1041.	1106.	1171.
		1.35)		18.41)	20.25)	22.10)	23.94)	25.78)	27.62)	29.46)	31.31)	33.15)
ROUTED TO	1	.52	1	110.	127.	143.	159.	175.	185.	198.	211.	224.
	1	1.35)	1	3.12)	3.59)	4.05)	4.52)	4.98)	5.25)	5.61)	5.97)	6.34)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	30.00	800.00	801.50
STORAGE	341.	341.	405.
OUTFLOW	0.	0.	154.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.12	801.24	0.00	394.	112.	0.00	17.17	0.00
.11	801.[illegible]	0.00	398.	127.	0.00	17.17	0.00
.13	801.[illegible]	0.00	402.	143.	0.00	17.08	0.00
.13	801.53	.03	407.	160.	2.00	17.08	0.00
.14	801.60	.10	411.	173.	2.67	17.00	0.00
.15	801.66	.16	416.	186.	3.08	17.00	0.00
.16	801.73	.23	420.	198.	3.50	17.00	0.00
.17	801.79	.29	425.	211.	3.75	17.00	0.00
.18	801.85	.35	429.	238.	4.00	16.92	0.00